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NEW MULTIPLEX TELEGRAPH APPARATUS FOR RADIO COMMUNICATIONS

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[Figures referred to herein are appended.]

Telegraphy in every country is being developed by the extensive introduction of start-stop apparatus, which offers great advantages over other systems. Among the special features of the start-stop apparatus are free manipulation of the keyboard, greater operating efficiency of the telegraph operators, a high degree of operational stability, and the excellent quality of the print.

Use of the start-stop apparatus for telegraphy has been greatly expanded in the Soviet Union. The development of tonal telegraphy has contributed to this expansion in a marked degree. As the number of tonal channels and systems of main line communications by cable increases, the start-stop apparatus may be expected gradually to replace the bodo apparatus.

Recently, in telegraphy, completely automatic start-stop apparatus of the T-19 type began to be introduced. With the aid of this apparatus relay transmission of through correspondence was carried on at communication centers. In USSR main-line communications, some correspondence passes over radio channels where the use of T-19 apparatus for simplex operation would be irrational because the traffic capacity of the radio channel is much greater than the capacity of the start-stop apparatus.

To profit by the valuable properties of a start-stop apparatus on channels of great traffic capacity and to introduce automatic relay transmission, the Telegraphic Laboratory of the Central Scientific Research Institute of Communications, at the suggestion of the author,

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developed a new multiple telegraph apparatus for radio communications, the TRT-1 (triplex radio teletype).

A single TRT-1 set consists of linear distributors on the order of a "nonaplex" /nine-segment/ bodo apparatus and three segments equipped with stop-start tape apparatus. Each segment consists of one T-19 apparatus for transmission and control, and one T-15 apparatus for reception.

The linear distributors differ in structure from the distributors of the nonaplex bodo apparatus only by another small slit of ring III of the transmitting disk, by the addition of a 46th shortened contact to ring I of the receiving disk, and by the halving of the length of the correction contact.

The technical speed of transmission for the TRT-1 apparatus, for instance, is equivalent to the speed of a hexaplex bodo apparatus, but its operational speed, because of automatic transmission, may be higher.

The TRT-1 apparatus permits great economy in personnel: servicing a hexaplex bodo apparatus requires a minimum of 12 telegraph operators per shift at each end of the line; under the same conditions, a TRT-1 apparatus employs eight operators. Furthermore, fewer operators are needed at relay transmission points.

The TRT-1 uses standard parts and mechanisms, which makes very rapid replacement possible.

Transmission

The TRT-1 apparatus is provided with automatic transmission on a line for each segment. Telegrams are perforated on a paper tape, which is then passed through the T-19 start-stop transmitter.

Figure 1 shows the transmission layout principle for a TRT-1 apparatus. This layout shows the six rings of a linear transmitting distributor, the distributor of the transmitter of segment I, the printing electromagnet of the control receiver, the output stage of the transmitter - tube panel, the starting relay of segment I transmitter, and printing control relay.

With every turn of the brushes of its distributor, the start-stop transmitter sends seven impulses: a starting impulse, five combination impulses, and a stopping impulse. The last named is long in comparison with the others.

These impulses go through the corresponding contacts of ring II and through ring V of the linear transmitting distributor to the radio transmitter.

The rate of rotation of the brushes of the transmitting distributor is fixed in such a way that the duration of signal from one contact of the linear distributor will be equal to one third of the duration of the actual signal of the start-stop transmitter.

After the transmission of one signal, the brushes of each transmitter of a TRT-1 set stop for a period equal to 0.58 of the duration of the elementary signal of the start-stop apparatus. Then the brushes begin to move again. By this method of rotation a local synchronism of the start-stop transmitter is produced in relation to the linear transmitting distributor.

The starting moments of a start-stop transmitter are determined by the starting impulses sent from the fixed contacts of ring III of the linear transmitting distributor to the starting relay. The latter controls the starting electromagnet of the transmitter.

For each turn of the brushes of the linear transmitting distributor, two operating and two pause impulses are sent to the starting relay windings. This occurs because, at each turn of the distributor brushes, each transmitter sends out two signals (two letters) to the line.

With the aid of the starting impulses, each start-stop transmitter is phased so that the brushes of ring II of the linear transmitting distributor take over the middle portion of the impulses sent by the start-stop transmitter.

Figure 2 shows a diagram of the distribution of impulses during transmission by the transmitter of segment I. As may be seen from this diagram, the phase of the transmitter of segment I is so arranged that the brushes of ring II take the linear transmitting distributor take over the middle third of each impulse sent by the transmitter. For example, the first contact of ring II is located in the middle third of the starting impulse of the transmitter and the fourth contact is located in the middle third of the first operating impulse and so forth.

Considering that out of each transmitter contact, only the middle third of a signal is used for transmission to the line, there may be a comparatively great allowance for phase deviation between the transmitter and the linear transmitting distributor. The transmitter phase may advance or lag by one third of the operating contact of the transmitter or by one contact of the linear distributor. Actually, there is never any such deviation if the speed of the transmitter is adjusted to the driving fork, and the friction contact of the axis of the brush holder of the transmitter lies within normal limits.

The position of the transmitter phase is determined by the starting impulses of the corresponding contact of ring III. The starting impulses are displaced, one to the next, for one contact of the linear distributor. Consequently, the phase of each transmitter is displaced for one contact.

The 23d and 47th contacts of ring II of the linear distributor pertaining to segment II and the 24th and 48th pertaining to segment III are not connected with the corresponding transmitters. The 23d and 47th contacts are connected to the positive of a line battery, and the 24th and 48th contacts, with the negative of a line battery to transmit correction impulses.

In the TRT-1 apparatus correction impulses are given from two diametrically opposed points in the circumference; hence, the correction is twice as frequent as in a nonaplex bodo apparatus. This is done to speed up correction in the receiving distributor.

The impulses sent to the line are simultaneously controlled by the control tube relay. Figure 1 shows the output stage of the control printing block, consisting of one tube (actually an output stage has two tubes in parallel).

In the TRT-1 apparatus, in contrast to the nonaplex bodo apparatus, the printing block for control and reception performs bipolar instead of unipolar operation at the output. This is done because in the TRT-1 the printing block impulses enter the winding of the polarized relay. To produce bipolar operation, a negative voltage is supplied to the printing block cathode (-40

or -50 volts). In addition, the rheostat supplies the tube grid with a negative voltage through a rheostat.

By adjusting the negative voltage on the tube grid with the rheostat, the positive and negative currents are equalized at the output.

In transmission to the line, the plate current from the tube of the control printing block enters through rings I and IV into the winding of the control printing relay. The latter controls the printing electromagnet of the control receiver.

The contacts connected with the winding of the control relay are alternated in two intervals. For this reason, the tongue of the control relay, after the impulse has been received in the winding, stops at one contact or the other until the brush of ring I has passed over three contacts. This re-established for the start-stop apparatus the normal signal duration, which has been shortened three times in transmission.

Reception

Figure 3 shows the receiving principle of a TRT-1 apparatus. It shows the rings of the linear receiving distributor, the receiver tube panel (in outline form), the printing electromagnet of the receiver, and the printing and correction relays.

In the receiver part of a TRT-1, only four rings -- I and IV, II and V -- take part in the operation of the linear distributor. Rings III and VI are not used because start-stop receivers do not require local synchronization.

Tonal frequency impulses, entering from the line, pass through the amplifier and rectifier and, through rings IV and I, act on a kallitrotron, which in turn, controls the printing block of the receiving panel.

The entire process of amplification, rectification, and control of signal duration with the aid of shortened contacts is conducted in the same manner in a TRT-1 as in a nonaplex bodo apparatus.

The receiver printing block consists of two 6L6 tubes (the diagram shows only one tube). Provision is made for bipolar operations at the printing block output, since the printing block acts on a polarized, neutrally regulated relay. To produce bipolar operation, negative voltage (-40 or -50 volts) is supplied to the tube cathode instead of the ground. Negative voltage is also supplied to the grid of the printing block tube through an adjustable rheostat. By adjusting the negative voltage on the tube grid with the rheostat, the positive and negative currents at the output are equalized.

The contacts of ring II of the linear receiving distributor are interconnected in the same way as the contacts of ring II of the transmitting distributor.

Positive or negative impulses, entering from the printing block, pass across rings V and II to the winding of the corresponding printing relay, shifting the tongue towards the right or left contact. The printing relay, with a battery only on one working contact, sends an impulse of unipolar current into the winding of the receiver's printing electromagnet.

For each segment, separate blanks enter from an opposite station and are admitted at ring II of the receiving distributor with delivery through three contacts. Consequently, the tongue of the printing relay, after being thrown over, remains at one contact or the other for the period

required for the passage of the brushes across the three disk contacts. By this means, the normal signal duration is re-established for the start-stop apparatus after having been shortened three times in transmission.

The winding of the TRT-1 apparatus correction relay is connected at one end with the 48th contact of ring II and is grounded at the other end.

During a normal phase of the linear receiving distributor, a positive impulse enters the 48th contact, turning the tongue of the correction relay to the left-hand idle contact (the windings of the correction relay are connected inversely as compared with the connection of the printing relay). During the interruption, a negative impulse enters the 48th contact of ring II turning the tongue of the correction relay to the right-hand working contact. At this moment there occurs an adjustment in the speed of the receiving distributor.

[Appended figures follow.]

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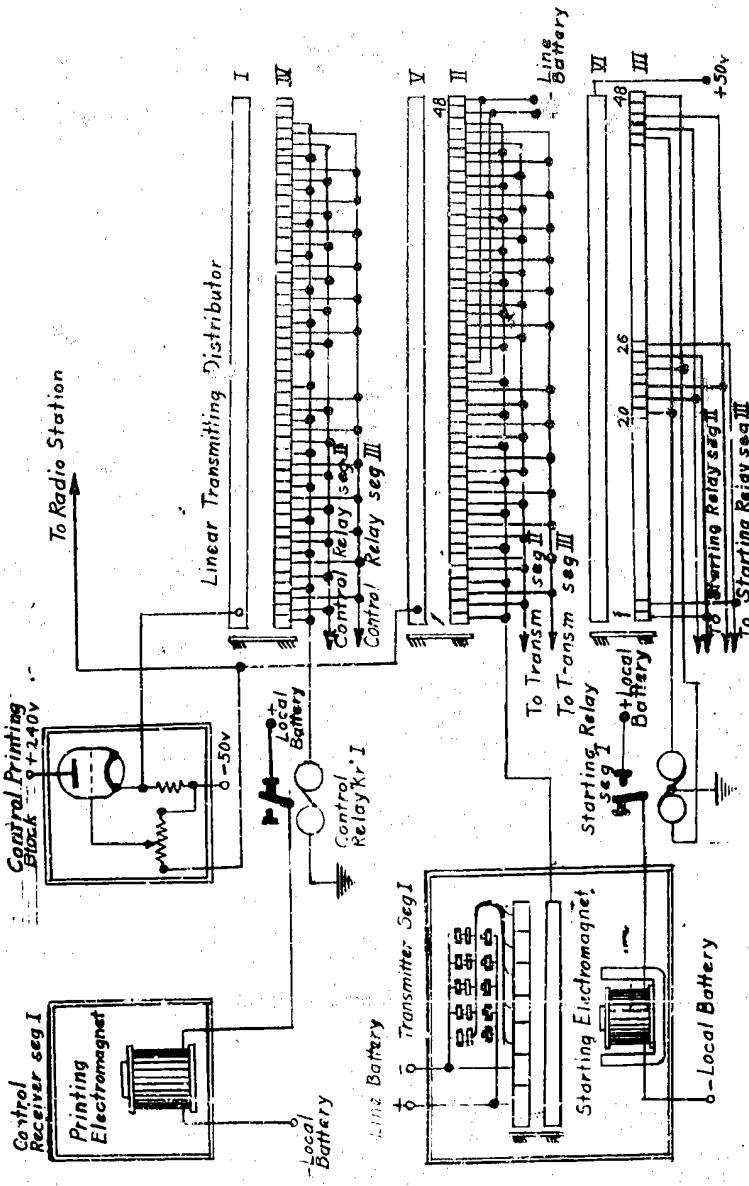

Figure 1

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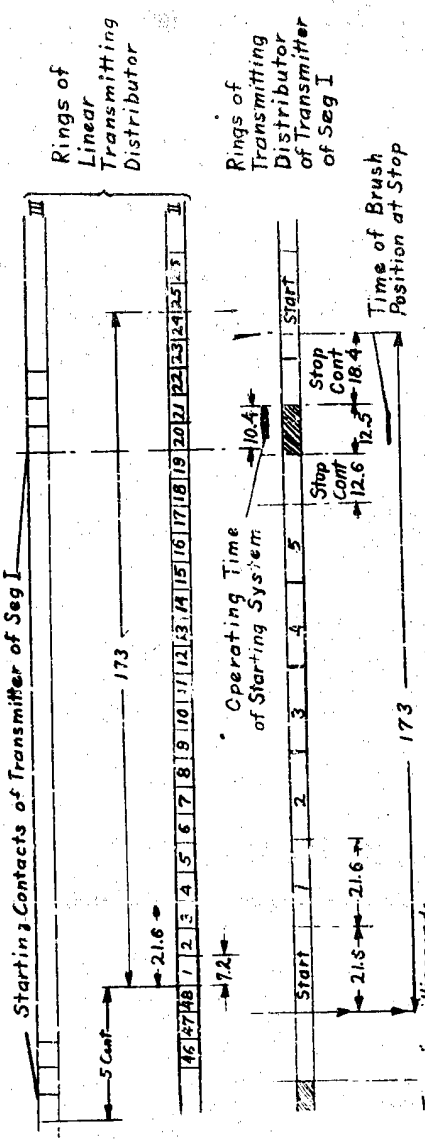

Figure 2

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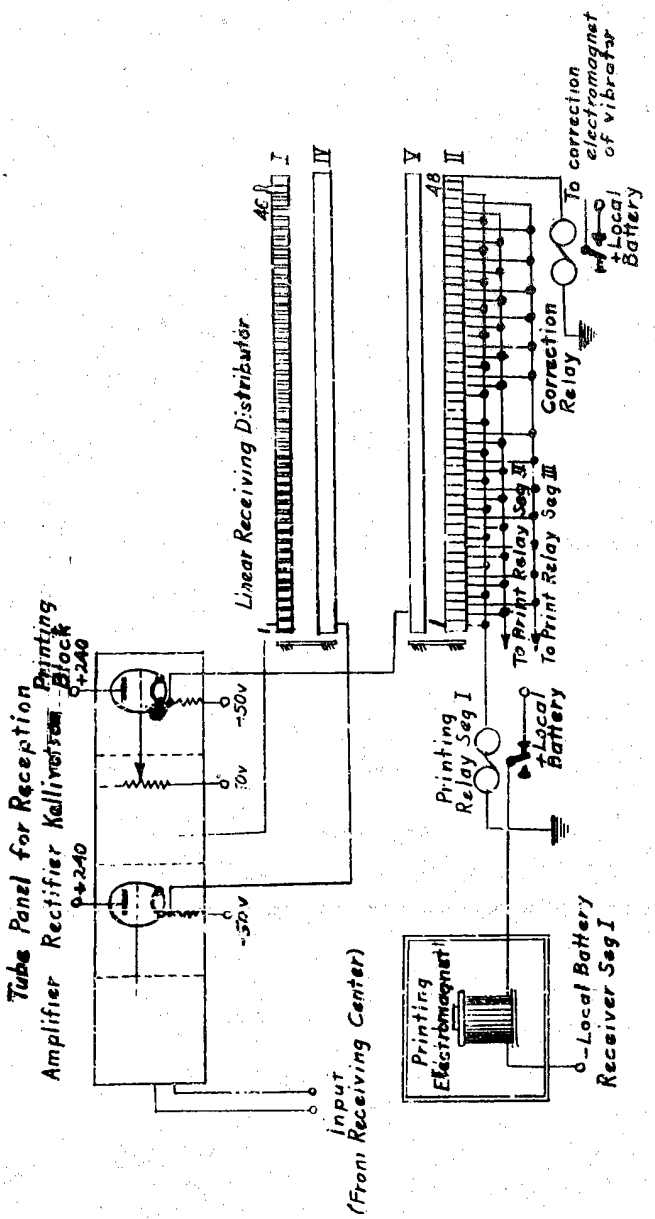

Figure 3

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